Chapter Three: Habitat, Fish and Wildlife

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A. Habitat

1. Forest systems

Terrestrial vegetation in the Nenana basin is composed of several overlapping vegetation systems. Biomes provide important habitat for fish, wildlife, and human survival. The generalized forest and tundra habitats are not exact and local conditions may vary.

Forests of the study area consist primarily of lowland spruce hardwood forest and bottomland spruce-poplar forest, low brush bog and muskeg, and some areas of upland spruce hardwood forest. Major forest groups of the Nenana basin are described below. Local species composition may vary.

Lowland spruce-hardwood forests are composed of mixed groupings of white spruce, paper birch, quaking aspen and balsam poplar with pure stands of black spruce, and open areas of shrubs, mosses and lichens. Some shrubs include willow, dwarf arctic birch, lingonberry, blueberry, Labrador tea, crowberry, and bearberry. This forest system provides important browse for moose (AEIDC, 1974:126).

Bottomland spruce-poplar forests consist of white spruce mixed with balsam poplar and tall cottonwoods. Birch, aspen, and black spruce also populate river terraces and flood plains. Young trees compete with aggressive shrubs including American green alder, thin-leaf alder, willow, rose, blueberry, raspberry, high bush cranberry, bearberry, Labrador tea, and many others. Grasses and plants characteristic of upland and lowland forests also dominate the forest floor. The tall trees of this system provide important feeding habitat for riparian animals including hawks, eagles, wolverines, and black bears (AEIDC, 1974:126).

Upland spruce hardwood forests are dense compositions of black cottonwood, white spruce, Alaska paper birch, quaking aspen, and balsam poplar trees. Shrubs living beneath the protective canopy include willow, alder, rose, high bush cranberry, lingonberry, raspberry, and currant. Plants inhabiting the floor include fireweed, horsetail, and several species of ferns, lichens, mosses, mushrooms, and fungi. Lower level organisms, like insects and fungi, are important for nutrient exchange and ultimate existence of creatures higher up the food chain. Young trees and shrubs in this forest provide food for moose, protective habitat for furbearers, and soil stabilizing root systems for erosion control (AEIDC, 1974: 127).

Dwarf shrubs and a thick mat of sedges, mosses and lichens dominate low brush bog and muskeg forests. Black spruce, western hemlock, and Alaska cedar are found in drier portions. Shrubs include Labrador tea, bog cranberry, willow, crowberry, blueberry, resin birch, and dwarf arctic birch. Plants include cotton grass, sedges, rushes, forbs, lichens, mosses, liverworts, mushrooms and other fungi. This system is especially important for many species of migrating and nesting waterfowl, and finfishes like salmon and trout (AEIDC, 1974: 130).

2. Wetlands

The study area has extensive wetlands, which play a major role in maintaining hydrologic systems and the quality and quantity of surface and ground waters. Minto Flats itself has over 500,000 acres created by the streams that meander through the area before flowing into the Tanana River. This creates a mosaic of deciduous and conifer stringers, old ponds and sloughs, floating mats, wet shrub and sedge types. Periodic flooding and fire make for a very dynamic and diverse region. Wetlands are extremely important to resident

and migratory birds for resting, feeding and nesting and can be important foraging grounds for large mammals such as moose and bear (BLM, 1989:3-43).

B. Fish and Wildlife Populations

The complicated pattern of vegetation types provides a variety of habitats for fish and wildlife populations using the area. The proximity to one another of complimentary vegetation types tends to make for rich values for a number of species. The mosaic of ponds, oxbows, stream channels, and various wetland and upland vegetation types provides excellent habitat for waterfowl, big game and furbearers (ADF&G, 2001:4).

1. Fish

The study area is ringed and crossed by rivers and streams that provide habitat for anadromous and resident fish species. All or part of the Tanana River, Nenana River, Seventeenmile Slough, Lost Slough, Teklanika River, Swanneck Slough, Tolovana River, Chatanika River, Kantishna River, and Toklat River have been specified as waters important for anadromous fish (AS 16.05.870). Portions of these waters provide migratory, spawning, and summer and winter rearing habitat for coho salmon, chinook salmon, summer chum salmon, and fall chum salmon (ADF&G, 2001). Numerous lakes, many interconnected with the rivers, are also included. Resident fish species use streams and lakes within the study area for the same life stages and for overwintering, varying with species and location. All waters that provide anadromous fish habitat also provide resident fish habitat, and several areas within the study area provide high quality for resident fish only. Some resident fish species are not extensively used by humans but are valuable as forage species for piscivorous species of fish, birds, and mammals.

The southeastern portion of the Nenana basin contains the lower Nenana River stream complex that contains important chinook, coho, and chum salmon spawning and rearing areas. While the main channel of the Nenana River is glacially turbid during most of the ice-free period, it has numerous clear side channels and tributaries. These shifting channels and clear-water upwelling areas in the Nenana River, Teklanika River, Seventeenmile Slough, Julius Creek, and Lost Slough area are routinely surveyed in the fall as index streams for spawning salmon (ADF&G, 2001). Stocks of Arctic grayling and round whitefish also spawn and rear in this area, and burbot, northern pike, and likely humpback whitefish are seasonally present (ADF&G, 2001, 2002b).

The Kantishna River system is a migratory route for chum and coho salmon, whitefish, and sheefish. Burbot are present in the mainstem Kantishna and the lower reaches of tributaries. Northern pike, Arctic grayling, whitefish, longnose suckers, and Alaska blackfish are present in suitable site channel and tributary habitat. Northern pike and sheefish are also present in Rock Creek, adjacent to the lower Kantishna River (ADF&G, 2002b).

In the southwest portion of the Nenana basin, the Toklat River and its tributaries provide important chinook, chum, and coho salmon spawning habitat. The Toklat Springs spawning area, upstream of the southern boundary of the study area, is an extremely productive fall chum salmon spawning area that is very important to the subsistence and commercial fisheries along the Tanana and Yukon rivers. In response to recent declines in salmon production and the importance of salmon to resource users, the Alaska Board of Fisheries adopted the Toklat River Fall Chum Salmon Rebuilding Plan (5 AAC 01.248) as guidance for conservative salmon management. The Toklat River chum salmon stock was also classified as a management concern by the Board of Fisheries in September 2000 in response to guidelines established in the Alaska Sustainable Salmon Fisheries Policy (5 AAC 39.222). This determination was based on a chronic inability of the fall chum salmon stocks to meeting the existing escapement goal for the Toklat Springs spawning area. The area is also heavily used by grizzly bears, furbearers, raptors, overwintering mallards, and other wildlife.

The Toklat Springs area has been designated under the Tanana Basin Area Plan (TBAP) as a candidate for legislative designation as a Critical Habitat Area under AS 16.20. Clear Creek (a tributary of the Kantishna River located southwest of the Toklat River with some headquarter sections located just inside the study area boundary) also provides important chinook salmon, coho salmon, and Arctic grayling habitat (ADF&G, 2001).

The Tanana River is the major migratory corridor for chinook, chum, and coho salmon that are moving to (as prespawning adults) and from (as smolt) spawning and rearing areas both within and upstream of the study area. All of the resident fish species present in the study area use the Tanana River mainstem, sloughs, backwater areas, connected floodplain waters out of the active river channel, and confluences with tributaries to varying degrees for migration, feeding, or rearing. The Tanana River carries a high silt load in the summertime, but clears in the winter when streamflow contributions from melting glaciers cease. This clear water contains high levels of dissolved oxygen and can sustain overwintering fish when nearby waters have become oxygen depleted and are causing "winter kill." Northern pike from western Minto Flats move into the Tanana River and Swanneck Slough and the lower Tolovana River (fed by the Tanana) to overwinter (Burkholder and Bernard, 1994). Other resident fish in the western Minto Flats are believed to exhibit the same behavior. In an analogous situation in the Tetlin National Wildlife Refuge area of the upper Tanana River basin, humpback whitefish move into overwintering areas of the Nabesna and Chisana rivers, and to the confluence where those rivers converge to form the Tanana River (Brown et al., 2002).

The Chatanika and Tatalina rivers, and Washington, Goldstream, and numerous smaller creeks flow into Minto Flats. These water bodies come together as tributaries to the Tolovana River, itself a tributary to the Tanana River at the southwestern end of the flats. The glacial Tanana River forms the southern boundary of Minto Flats, and two major sloughs of the Tanana (Swanneck Slough and Grassy Slough) cut into the flats and flow into the lower Tolovana River. Except for the Tanana River, the waterways of the flats are slow and meandering. The lakes of Minto Flats are generally shallow and heavily vegetated. An interconnected group of lakes, specifically called the "Minto Lakes," connect to Goldstream Creek in the eastern part of Minto Flats. Big Minto Lake and Upper Minto Lake are the largest of these lakes. Large lakes in the western flats include Whitefish Lake, Cooper Lake, and Rock Island Lake. In general, these lakes are shallow and contain large areas of dense aquatic vegetation. The water level and surface area of standing water in Minto Flats is quite variable from summer to summer and sometimes within a summer, and is driven by a combination of the river stage of the Tanana River and of the rivers and streams flowing into and through the flats. When water in the flats is high, as it often is in spring, streams frequently flow outside their channels, lakes can merge, and fish distribute over a wide area of flooded wetlands (Scanlon, 2001). During periods of lower water level, fish occupy deeper lakes and stream channels. There are about 27,000 acres of northern pike summer habitat spread over the approximately 500,000 acres within the MFSGR (Holmes and Pearse, 1987). In winter much of the flowing and standing water in the flats becomes anoxic, forcing fish to move to waters of the Tanana River or upstream in tributary rivers to oxygenated areas (Doxey, 2001). Fish species present in Minto Flats include chinook salmon, chum salmon, northern pike, Arctic grayling, sheefish, burbot, least cisco, humpback whitefish, broad whitefish, round whitefish, longnose suckers, Alaska blackfish, lake chub, slimy sculpin, and Arctic lamprey. Adult coho salmon have been observed in the Chatanika River, indicating that there may be a small spawning run.

The Tolovana River, lower Chatanika River, Tatalina River, and associated waters of western Minto Flats provide spawning, rearing, and limited overwintering habitat for northern pike. The Chatanika River, lower Goldstream Creek, and associated waters of eastern Minto Flats are important for pike spawning, rearing, and overwintering. The Minto Lakes are a major northern pike spawning and summer feeding area within Minto Flats. When spring water levels are high in Minto Flats and large areas of the flats are inundated, northern pike spread throughout the inundated area to spawn. Expanses of shallow water with emergent vegetation provide essential high quality rearing areas for young-of-the-year northern pike.

ADF&G considers the northern pike of Minto Flats to consist of two spawning stocks. The eastern stock spawns primarily in the Minto Lakes/Goldstream drainage, and the western stock spawns primarily in the Tolovana drainage. The stocks are not completely segregated, and considerable interchange occurs. Most recent (2000) estimated abundance of northern pike in Minto Lakes is 5,300 fish over 600 mm (23") in fork length, with a higher proportion of larger, older northern pike than in the 1997 estimate. The abundance estimates in 1996, 1997, and 2000 indicate that the Eastern Minto Flats population has been relatively stable recently (Scanlon, 2001). Prior studies provided estimates of abundance of northern pike larger than 400 mm (16") in fork length. While abundance of the 400-mm to 600-mm cohort could not be directly estimated in 2000 due to high water that made sampling difficult, expected proportionality based on previous estimates indicates that abundance of northern pike larger than 400 mm was about 16,000 fish, which compares favorably with previous abundance estimates. An abundance and composition estimate of northern pike in the Minto Lakes during spring and early summer of 2003 is a high priority of ADF&G Division of Sport Fish.

Radiotelemetry studies indicate that up to one-third of the Minto Lakes northern pike overwinter successfully in the Minto Lakes in some years. The majority leave the lakes and Goldstream Creek, and ultimately overwinter in the Chatanika River upstream from Goldstream Creek. Minto Lakes northern pike move to overwintering areas from freeze-up until after early December, and can begin returning to spawn after early March. Peak movement to Minto Lakes spawning areas was in late April and early May in 1996 (Roach, 1998). Timing of movement of northern pike in the western Minto Flats to and from the lower Tolovana River, Grassy Slough, and the Tanana River near the mouth of the Tolovana is similar. The location of overwintering areas and the timing of migration to and from those areas are likely driven by dissolved oxygen levels (Burkholder and Bernard, 1994). Dissolved oxygen levels and oxygen depletion rate during each winter probably are dictated by water level (volume) at freeze-up, flow rate through the winter (in streams), and the severity and length of the winter. Sufficient anecdotal evidence and observations exist to establish that fish become trapped in areas of oxygen depletion and that winterkills occur in Minto Flats. Local residents report seeing large numbers of dead northern pike along the margins of Goldstream Creek during some spring breakups. In March of 1984, while traveling on snowmachines, ADF&G biologists found an aggregation of fish of several species frozen into the ice of the lower Tolovana River (ADF&G 2002b).

In addition to northern pike, other species found in the Minto Lakes (and by inference, other interconnected lakes of Minto Flats) include humpback whitefish, least cisco, broad whitefish, round whitefish, longnose suckers, and burbot. These species have only been documented in the Minto Lakes during summer, but no directed studies have assessed their distribution after freezeup. Alaska blackfish are extremely tolerant of low dissolved oxygen levels and are frequently found in lakes in which no other fish are likely to survive.

Whitefish (and ciscoes) spawn in the fall, and move to rivers in late summer as the spawning migration begins. Major runs of humpback whitefish and least ciscoes move up the Chatanika River to spawn upstream from Minto Flats to near the Elliot Highway bridge each fall, after which they move back downstream (Fleming, 1999, Doxey, 2001). Overwintering areas of these fish are undocumented.

The Tolovana and Chatanika rivers in Minto Flats are migratory pathways for the Chatanika River chinook and chum salmon stocks. Adult chinook and chum salmon move through in mid- to late summer to spawn in the Chatanika River upstream from Minto Flats. Smolts of both species migrate downstream at breakup. Chinook and chum salmon have also been documented in the Tolovana River upstream from its confluence with the Chatanika. Adult coho salmon have been seen in the Chatanika River.

Arctic grayling and round whitefish are present in all of the major, named rivers and streams flowing through Minto Flats. Most probably spend the summer upstream from Minto Flats.

Sheefish rear and feed in the Tolovana River and Chatanika River in Minto Flats through most of the summer. They migrate up the Chatanika River toward spawning areas beginning in August. Spawning occurs

in September and October, after which the sheefish move downstream. Nothing is known about the overwintering habits or early life history of Chatanika River sheefish, except that they are the only documented spawning stock in the Tanana River drainage. The subadult sheefish present in the lower Chena River and other tributaries of the Tanana downstream from the Chena River are thought to originate in the Chatanika River.

Burbot are common in the Tolovana and Chatanika Rivers and lower reaches of the smaller tributaries. A few are present in summer in the lakes. Burbot are winter spawners, and the Tolovana/Chatanika stocks likely spawn in the Tanana River adjacent to Minto Flats.

Table 3.1: Fishbearing Waterbodies in and Near the Study Area

River/Creek/Lake	*Species Present*
Chatanika River	*K CO CH AG WF B NP SF*
Clear Creek	*K CO CH AG WF B NP*
Deadman Lake	*WF B NP*
Dune Lake	*CO AG RT*
Firebreak Lake	*RT*
Glacier Creek	*K CO AG WF B NP*
Grassy Slough complex	*AG WF B NP SF*
Iksgiza Lake	*NP*
Julius Creek	*K CO AG WF B NP*
Kantishna River	*K CO CH AG WF B NP SF*
Lost Slough	*K CO CH*
Lower Goldstream Creek	*AG WF B NP SF*
Minto Lakes	*WF B NP*
Nenana River	*K CO CH AG WF B NP*
Oblique Lake	*RT*
Rock Creek	*NP*
Seventeen Mile Slough	*K CO CH AG WF B NP*
Swanneck Slough	*K CO CH AG WF B NP SF*
Tanana River	*K CO CH AG WF B NP SF*
Tatalina River	*AG WF B NP SF*
Teklanika River	*CO CH AG WF B NP*
Toklat River	*K CO CH AG WF B NP*
Tolovana River	*K CO CH AG WF B NP SF*
Totchaket Slough	*WF B NP SF*
Upper Goldstream Creek	*AG WF*
Washington Creek	*AF WF*

K= chinook salmon; CO= coho salmon; CH= chum salmon; AG= Arctic grayling; W=whitefish; B= burbot; NP= northern pike; RT= rainbow trout; SF= sheefish

NOTES: The whitefish complex (WF) includes round, broad, and humpback whitefish, and least cisco; not all species are found in the same waters together. Arctic grayling (AG) are ubiquitous throughout the connected water bodies listed; some areas of high value are listed in the table. Most water bodies connected to those listed in the table (including sloughs and distributaries), and a number of isolated water bodies in which fish can overwinter, also contain fish. Several species of fish not extensively used by humans for personal, subsistence, sport, or commercial purposes are present in most water bodies within the study area, including Alaska blackfish, Arctic lamprey, longnose suckers, lake chub, and slimy sculpin. Source: ADF&G, 2001a

Some combination of longnose suckers, slimy sculpin, and lake chub are present in most flowing waters and in lakes connected at least seasonally to rivers or streams. Alaska blackfish are present in sloughs, larger lakes, and in many smaller, landlocked lakes throughout the study area (ADF&G, 2001). Adult Arctic lamprey is reported to move through Minto Flats to spawn in the Chatanika River in the springtime, and ammocoetes larvae (juvenile lampreys) rear in the rivers. General descriptions of these fishes and their life history can be found in Scott and Crossman (1973).

Chinook salmon *(Oncorhynchus tshawytscha)* are distinguished by the black irregular spotting on the back and dorsal fins and on both lobes of the caudal or tail fin. Alaska streams normally receive a single run of chinook salmon in the period from May through July. Chinook salmon often make extensive freshwater spawning migrations to reach their home streams on some of the larger river systems. Yukon River spawners bound for the extreme headwaters in Yukon Territory, Canada, will travel more than 2,000 river miles during a 60-day period. Each female deposits from 3,000 to 14,000 eggs in several gravel nests, or redds, which she excavates in relatively deep, moving water. In Alaska, the eggs usually hatch in late winter or early spring, depending on time of spawning and water temperature (ADF&G, 1994).

Coho Salmon (*Oncorhynchus kisutch*) usually weigh 8 to 12 pounds and are 24 to 30 inches long, but individuals weighing 31 pounds have been landed. Coho salmon enter spawning streams from July to November, usually during periods of high runoff. The female digs a nest, called a redd, and deposits 2,400 to 4,500 eggs. As the eggs are deposited, the male fertilizes them with sperm. The eggs develop during the winter, hatch in early spring, and the embryos remain in the gravel utilizing the egg yolk until they emerge in May or June. The emergent fry occupy shallow stream margins, and, as they grow, establish territories, which they defend from other salmonids. They live in ponds, lakes, and pools in streams and rivers, usually among submerged woody debris-quiet areas free of current, from which they dart out to seize drifting insects. During the fall, juvenile coho may travel miles before locating off-channel habitat where they pass the winter free of Floods. They spend one to three winters in streams and may spend up to five winters in lakes before migrating to the sea as smolt (ADF&G, 1994).

Chum salmon *(Oncorhynchus keta),* also known as "dog salmon" and are a traditional source of dried fish for winter use. There are a higher percentage of chums in the northern areas of the state. Chum vary in size from 4 to over 30 pounds, but usually range from 7 to 18 pounds, with females usually smaller than males. Chum salmon often spawn in small side channels and other areas of large rivers where upwelling springs provide excellent conditions for egg survival. Female chum may lay as many as 4,000 eggs, but fecundity typically ranges between 2,400 and 3,100 eggs. Chum do not have a period of freshwater residence after emergence of the fry, as do chinook, and coho salmon. Chum fry feed on small insects in streams and estuaries (ADF&G, 1994).

High value resident fish species (including Arctic grayling, burbot, northern pike, round whitefish, and sheefish) are also present in the study area. All water bodies that provide anadromous fish habitat also provide resident fish habitat. In addition, several areas within the study area provide high quality habitat for resident fish only. The Nenana River/Seventeenmile Slough/Lost Slough area is important for Arctic grayling and round whitefish spawning and rearing, burbot, northern pike, and likely humpback whitefish. The Kantishna River is an important migratory route for whitefish and sheefish, and is a major producer of burbot and northern pike. Rock Creek, at the lower end of the Kantishna, is the site of an important spring and summer northern pike fishery (ADF&G, 1994).

Northern pike *(Esox lucius).* Minto Flats is well known for its large northern pike and provides an abundance of feeding habitat for this species (ADF&G, 1992:A-12). Pike of up to 20 pounds are common in some Alaskan rivers, lakes, and sloughs, and fish weighing up to 30 pounds and measuring 4 ft. in length have been caught. Spawning occurs in spring soon after the ice goes out. A 25- to 30-pound female may contain up to half a million eggs which she deposits in the grassy margins of lake shores, slow-moving streams, or sloughs. The eggs drop to the bottom where they adhere to grass, rocks, or other debris. Because

of the colder temperatures of Alaskan waters, incubation may take 30 days. Very little is known of the winter habits of pike in Alaska. However, it is known that most pike overwinter in the deep, slow waters of larger rivers because shallow lakes become depleted of oxygen (ADF&G, 1994).

Arctic grayling *(Thymallus arcticus)* is an elegantly formed cousin of the trout. With its sail-like dorsal fin dotted with large iridescent red or purple spots, the grayling is one of the most unusual and beautiful fish of Alaska. Like salmon, grayling faithfully return every year to the same spawning and feeding areas. Grayling spawn for the first time at an age of 4 or 5 years and a length of about 11 to 12 inches. About one month after spring breakup, adult grayling begin their post-spawning migration to summer feeding areas. Depending on where they have spawned, the distance traveled can be up to 100 miles. Grayling are generalists in their food habits, but drifting aquatic insects, especially mayflies, stone flies, and caddis flies are their primary food items. At times grayling will gorge upon the eggs of spawning salmon, outmigrating salmon smolts, and terrestrial insects that have fallen into the water (ADF&G, 1994).

The **burbot** *(Lota lota)* is a valuable food and recreational fish. The burbot has a thin, elongated body that tapers to a point near the tail. Its major distinguishing characteristics are a "chin whisker" or barbel, and dorsal and anal fins that run from the middle of the body almost to the tail. The tail is rounded rather than fork shaped. The mouth is quite large and contains numerous rows of small teeth that slant back toward the throat. Burbot have mottled olive-black or brown skin interspersed with yellow patches. Burbot appear to be scaleless but actually have small, almost microscopic scales. Burbot are a relatively long-lived and slow-growing species. Burbot spawn under the ice in late winter (February to March) and have been observed to mill together forming a large writhing ball while spawning. Eggs are very small, and an individual burbot can produce over a million eggs. Young burbot feed mainly on insects and other invertebrates, but by the age of 5, burbot feed almost exclusively on fish. Adult burbot can appear sluggish, but they are voracious predators, feeding mostly at night. Once a burbot has captured a fish, it is reluctant to give it up. Its large mouth, strong jaw, and large number of inward slanting teeth account for the burbot's efficiency as a predator. Whitefish, sculpins, lampreys, and other burbot are common food items (ADF&G, 1994).

Round whitefish *(Prosopium cylindraceum)* have rounded cigar-like bodies with tiny, pointed snouts and single nasal flaps. The upper jaw extends out over the lower so the mouth is underneath, or inferior. The young have parr marks, dark transverse bands, which disappear in the second year of life. The pygmy whitefish has a toothless mouth and large eyes. Round whitefish in most streams seldom exceed 16 inches in length, while pygmy whitefish rarely reach 8 inches. Whitefish are important in the food chain of the aquatic community, as they are a major food item for many predatory fish (ADF&G, 1994).

The **sheefish** (*Stendous leucichthys*) in Alaska have been separated into five major stocks. The Minto Flats and Upper Yukon River populations are year-round residents in the eastern part of Interior Alaska. Some sheefish spawn every year, but every other year is probably the rule in most populations. A 12-pound female may contain 100,000 eggs while a 50-pound female contains nearly 400,000 eggs. Sheefish have very stringent spawning ground requirements. The water must be from 4 to 8 ft. deep with fast current over a bottom composed of differentially sized gravel. Spawning occurs during late afternoons and evenings in late September and early October in water of 40° F or colder. Development of the eggs proceeds slowly in the cold water, with up to six months elapsing before hatching. The fry travel downstream with spring floods to the extensive delta areas of the large rivers. They begin to feed on plankton. Their diet rapidly changes to insect larvae and small fish, and by the second year of life they feed almost entirely on fish. Adults eat any fish available. For an arctic freshwater species, the sheefish exhibits a rapid rate of growth. Studies have shown that fish of each stock exhibit distinct growth rates, have a different life span, and reach sexual maturity at different ages. Fish of the Kuskokwim and Minto Flats populations grow the fastest. They reach 16 inches in length at age two, and up to 30 inches in length and weights to 14 pounds by age eight (ADF&G, 1994).

The **rainbow trout** *(Oncorhynchus mykiss)* possess the well-known streamlined salmonid form, though body shape and coloration vary widely and reflect habitat, age, sex, and degree of maturity. The body shape may range from slender to thick. There is a reddish-pink band along each side about the midline that may range from faint to radiant. Release of hatchery-reared Alaska rainbow trout has extended the range of resident rainbows to specific landlocked lakes in the Tanana River drainage near Fairbanks. These fish are triploid and cannot produce viable spawn.

Three lakes within the study area have been stocked with rainbow trout by ADF&G's Division of Sport Fish, all south of the Tanana River. Dune Lake (T6W, R12W) and Firebreak Lake (T4S, R12W) support active sport fisheries, and "Oblique" or "Tschute" Lake (T2S, R13W) lies within the Tanana Valley State Forest's Oblique Lake Research Natural Area (ADF&G, 2001). Coho salmon and Arctic grayling are also stocked into landlocked waters within the study area. Information about the recreational fisheries stocking program can be found in the ADF&G stocking plan (ADF&G, 2002c).

2. Birds

Minto Flats constitutes one of the highest quality waterfowl nesting and staging habitats in Alaska, especially along its eastern edge around Big Minto Lakes, and supports some of the highest densities of waterfowl on the continent (Lindberg, 2002 citing to Conant and Hodges, 1985). Waterfowl nests are distributed throughout the refuge, with birds nesting in a wide range of habitat. Densities of 3,885 nests per mi^2 in some of the most productive habitats have been recorded (Lindberg 2002, citing to Petrula 1994).

Migratory waterfowl including diving and dabbling ducks use Minto Flats during spring migration, while large concentrations of cranes, geese, and loons use the area for fall staging prior to southern migration. Migratory waterfowl arrive in Fairbanks and, presumably, Minto Flats as early as mid-April and nesting commences in late April or early May, with the latest nest initiated in early July (Lindberg citing to Petrula 1994). Some ducks may renest if their initial nest attempt fails (Lindberg 2002, citing to Mann and Sedinger 1993). Waterfowl nest in most low-lying portions of Minto Flats, with highest densities in open grass/sedge meadows. Boreal forests, alder-willow thickets, and mixed shrub habitats are also used for nesting.

Minto Flats has long been a popular destination for waterfowl hunters in the fall (ADF&G, 2001:4). As much as 12 percent of the annual duck harvest in Alaska comes from this refuge (ADF&G 1998).

Trumpeter Swans *(Cygnus buccinator)* in Alaska represent about 80 percent (13,000) of the Trumpeter Swans in North America and breeding swans in Alaska are therefore a critical component of the continental population (USFWS, 1995). Nesting swans and swan families are widely distributed throughout the MFSGR, with swans nesting in both the northern and southern portion of the refuge (Lindberg citing to Migratory Bird Management).

Trumpeter swans prefer secluded regions, where they frequent shallow bodies of water and build their nests in extensive areas of marsh vegetation. Most breeding pairs are at their nest sites by early May and the first hatching dates range from June 16 to June 29. In Alaska, young swans are unable to fly until 13 to 15 weeks of age. Most swans depart by mid-October but in some years may remain until freeze-up in November (ADF&G, 1985b:160). They winter on ice-free freshwater outlets. However, they may utilize saltwater, during extremely cold periods, when freshwater locations freeze (ADF&G, 1985b:158).

The U.S. Fish and Wildlife Service (USF&WS) Division of Migratory Bird Management performs regular migratory waterfowl surveys. In August 2000, the Trumpeter Swan survey counted 2,122 swans in the Minto Flats area. Sightings included 1,072 adults in pairs, 353 cygnets, 75 single adults, and 622 swans in 67 different flocks. Between 1984 and 1998, USF&WS observed a total of 2,225 Trumpeter Swan nests during 14 surveys, for an annual average of 159 (range 48-267) nests. The total number of swan broods observed

between 1968 and 2000 during 21 surveys in the Minto Flats area was 2,233, for an annual average of 106 (range 15-198) broods (USDOI, 2002). ADF&G reports seeing 110 Trumpeter Swans on Black Bear Lake in the fall of 2001 (ADF&G, 2001a). Swans have been observed staging on this lake in previous years as well, typically in late September.

Fifteen species of **ducks**, and two species of **geese** nest and raise their broods at Minto Flats (Lindberg 2002, citing to Hooper 1952, Rowinski 1958, Bellrose 1980, Petrula 1994). Breeding waterfowl are distributed in the northern (core) and southern area of the refuge. The 15 species of breeding ducks include Northern Pintail (*Anal acuta*), Mallard (*Anas platyrhynchos*), Northern Shoveler (*Anas clypeata*), Green-winged Teal (*Anas crecca*), American Widgeon (*Anas americana*), Gadwall (*Anas strepera*), Lesser Scaup (*Aythya afnis*), Greater Scaup (*Aythya marila*), Canvasback (*Aythya valisineria*), Ring-necked Duck *(Aythya collaris),* Blue-winged Teal (*Anas discors*), Redhead (*Aythya americana*), Bufflehead (*Bucephala albeola*), Common Goldeneye (*Bucephala clangula*), Barrow's Goldeneye (*Bucephala islandica*), Surf Scoter *(Melanitta perspicillata)*, White-winged Scoter (*Melanitta fusca*)and Common Merganser *(Mergus merganser)*.

The two goose species breeding at Minto are Greater White-fronted Geese *(Anser albifrons)* and a small race subspecies of Canada Geese *(Branta canadensis spp.)*. Lesser Snow Geese *(Chen caerulescens)* associated with the only breeding colony of snow geese in Russia (Lindberg 2002, citing to Bousfield and Syroechkovsky 1985), stage at Minto Flats during their spring migration to more northern breeding habitats (Lindberg 2002, citing to Bellrose 1980).

Aerial strip transect surveys are conducted annually as part of the Alaska Waterfowl Breeding Population Surveys. Ten-year (1992-2001) average observed duck densities from the three transects within the MFSGR north of the Tanana River are 87.7 (range 20-179), 64.9 (37-101), and 49.9 (29-85) birds per mi^2, and those from the two transects within the refuge south of the Tanana are 11.85 (8-17) and 0.8 (0-3) birds per mi^2 (USDOI, 2002).

Waterfowl undergo wing molt June-September, and adult birds are flightless for about 20-35 days per year (Hohman et al. 1992). Ducklings, goslings, and cygnets are flightless for about 35 days (e.g., Green-winged Teal, Hooper 1951) to 15 weeks (e.g., Trumpeter Swans, Lindberg 2002, citing to Bellrose 1980). Flightless Trumpeter Swans and their cygnets use most of the wetlands in the northern and southern portions of the refuge (Lindberg 2002, citing to Migratory Bird Management).

Bald eagles *(Haliaeetus leucocephalus)* are a common and visible raptor in the study area. These birds are protected by the federal Bald Eagle Act of 1940, which makes possession of an eagle, either alive or dead, illegal (ADF&G, 1994). Eagle distribution is influenced by the availability of open water and anadromous streams containing adequate food resources. Eagles concentrate around spawning streams during fall and winter. Juveniles utilize spawned-out salmon as a major food source (Mickelson, 1989). Eagles are most abundant from spring through fall during the nesting and brood rearing season.

Bald eagle nesting sites are abundant in the study area. The criteria for bald eagle nesting sites include: areas usually within 200 yards of rivers; large lakes and streams, which are known to support an adequate food supply; mature tall trees with limbs that can support a nest of possibly 1000 pounds; and sites away from human activity. Bald eagles may also nest on cliffs, sea stacks, or rock promontories near a water body (Rappoport, 2000).

Interior populations prey heavily upon salmon. Eagles also prey upon waterfowl, small mammals and carrion. (ADF&G, 1994). Eagle populations are healthy throughout Alaska. Golden eagles *(Aquila chrysaetos),* also protected by the Bald Eagle Act, are found throughout the study area. These raptors feed primarily on ground squirrels, hares, and birds, such as ptarmigan, cranes, and owls. (ADF&G, 1994).

Chickadees *(Parus atricapillus)* are common throughout Alaska's forests with some species associated with conifers and others with deciduous forest cover. These small birds live an average of 2 to 3 years, and feed on insects, including several considered forest pests. Hawks and other flying predators eat chickadees. Boreal chickadees *(P. hudsonicus)* are found in the coniferous forest of central and western Alaska.

Both the **Sharp-shinned Hawk** *(Accipiter striatus)* and the **Northern Goshawk** *(Accipiter gentilis)* are abundant in Alaska, but rarely seen. These birds, which are natural enemies, nest in woodland forests most frequently in middle age (20-45 years old) spruce trees. Eggs hatch in late May or early June. Goshawks eat snowshoe hares, grouse, ptarmigan, ducks, squirrels, voles, shrews, and some songbirds and shorebirds. Sharp-shins eat songbirds, small mammals and large insects. While hawks have few natural predators, sometimes bears, lynx, and other climbing predators can reach their nests (ADF&G, 1994).

The **Boreal Owl** *(Aegolius funereus)* occurs throughout the forested areas of the Interior. Owls nest in closed-canopy forests with at least some deciduous trees. Owls feed at night on voles, mice, shrews, and small birds. Marten are the main predator of the Boreal owl, and population cycles of voles are a limiting factor in owl populations. The Northern Hawk Owl *(Surnia ulula)* occurs throughout the forested areas of the Interior. The owl hunts mostly during the day, is noted for its unusual tolerance of human activity, and will nest close to human settlements. In the Denali area, these owls feed primarily on red-backed voles and mice. Main predators are the Great Horned Owl and Northern Goshawk (ADF&G, 1994).

The **Common Raven** *(Corvus corax)* is a member of the Corvidae family, which also includes jays, crows, and magpies. The raven is the largest all-black bird in the world. Ravens feed on a variety of both plant and animal foods, and are accomplished scavengers. Ravens breed at age 3 or 4 years, mate for life, and can live up to 30 years. Ravens congregate near human settlements during non-breeding times (ADF&G, 1994).

Spruce grouse *(Canachites canadensis)* or spruce hens are common throughout Alaska. Preferred habitat includes spruce-birch forest with a thick understory of cranberry, blueberry, crowberry, and spirea, above a moss-covered ground. During summer, spruce grouse eat flowers, green leaves, and berries. Insects provide food for newly hatched chicks. Ruffed grouse *(Bonnasa umbellus)* are common to woodlands along interior Alaska rivers. Summer foods include blueberries, high-bush cranberries, rose hips, and aspen buds. In winter, they feed primarily on the buds and twigs of aspen, willow, and soapberry. Game bird populations in Alaska fluctuate in a 10-year cycle (ADF&G, 1994).

Willow ptarmigan *(Lagopus lagopus),* Alaska's state bird, are found everywhere throughout Alaska's high, treeless country. Rock and White-tailed ptarmigan also inhabit all major treeless area of southern Alaska. Willow ptarmigan tend to live closest to the tree line. Hens nest on the open ground after snowmelt and hatchlings arrive in late June or early July. Ptarmigan populations fluctuate dramatically and the causes remain a mystery (ADF&G, 1994).

Common loons *(Gavia immer)* spend the summer on lakes throughout the interior. Red-throated loons are also common throughout the state. Loons migrate to coastal areas in September or early October, and return to their freshwater nesting habitat in May. Loons mate for life and return each year to the same area to breed. Breeding success may be related to the presence of gulls, jaegers, and foxes. Loons are also susceptible to disturbance by floatplanes and fishers who force them to abandon their nest allowing the chicks to chill and die. Loons are excellent divers and feed on small fish, aquatic vegetation, insects, mollusks, and frogs (ADF&G, 1994).

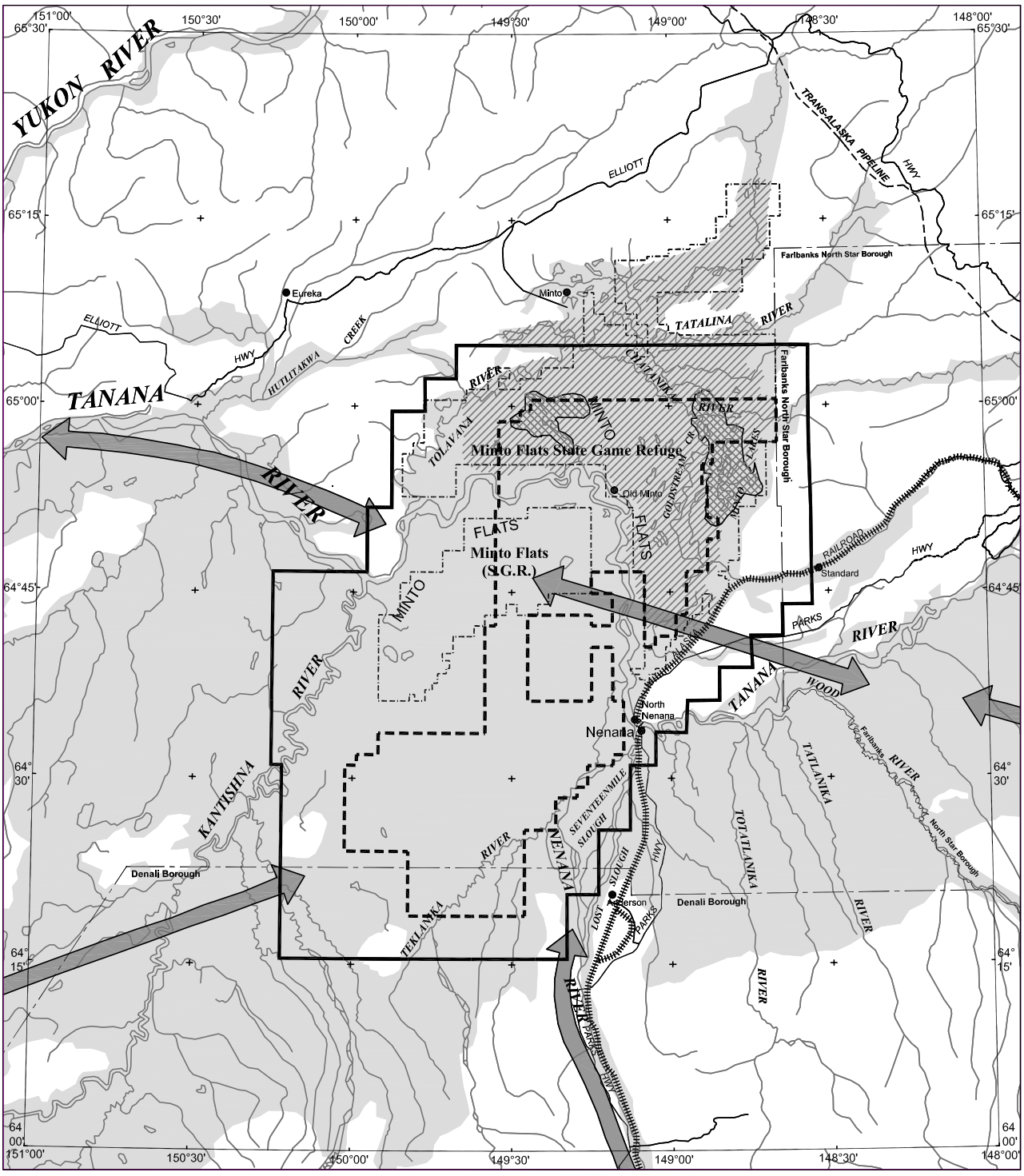

FIGURE 3.1 Ducks and Geese

Nenana Basin Study Area = License Area =

General Distribution = Known Migration = Known Nesting = Spring and Fall Concentrations =

Source: ADF&G, 1986a

Map Area

SCALE 1:750,000 One Inch Equals 12 Miles Approx.

10 0 10 20 30 40 50 Miles

10 0 10 20 30 40 50 60 Kilometers

Map created, edited, and published by the State of Alaska, Department of Natural Resources, Division of Oil and Gas.

Albers Equal-Area Conic Projection, 1927 North American Datum, Clarke 1866 ellipsoid with a central meridian of 149° 30', origin latitude of 50°, northern parallel of 65°, and southern parallel of 55°. ADNR 7/02

Table 3.2 Birds Commonly Observed in the Vicinity of the Study Area

Common Name	*Scientific Name*
Pacific Loon	*Gavia pacifica*
Common Loon	*Gavia immer*
Horned Grebe	*Podiceps auritus*
Red-necked Grebe	*Podiceps grisegena*
Greater White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen caerulescens*
Canada Goose	*Branta canadensis*
Trumpeter Swan	*Cygnus buccinator*
Tundra Swan	*Cygnus columbianus*
Eurasian Wigeon	*Anas penelope*
American Wigeon	*Anas americana*
Mallard	*Anas platyrhynchos*
Northern Shoveler	*Anas clypeata*
Northern Pintail	*Anas acuta*
Green-winged Teal	*Anas crecca*
Canvasback	*Aythya valisineria*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*
Harlequin Duck	*Histrionicus histrionicus*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*
Oldsquaw	*Clangula hyemalis*
Bufflehead	*Bucephala albeola*
Common Goldeneye	*Bucephala clangula*
Barrow's Goldeneye	*Bucephala islandica*
Common Merganser	*Mergus merganser*
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Northern Goshawk	*Accipiter gentilis*
Red-tailed Hawk	*Buteo jamaicensis*

Rough-legged Hawk	*Buteo lagopus*
Golden Eagle	*Aquila chrysaetos*
American Kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Gyrfalcon	*Falco rusticolus*
Peregrine Falcon	*Falco peregrinus*
Ruffed Grouse	*Bonasa umbellus*
Spruce Grouse	*Falcipennis canadensis*
Willow Ptarmigan	*Lagopus lagopus*
Rock Ptarmigan	*Lagopus mutus*
Sharp-tailed Grouse	*Tympanuchus phasianellus*
Sandhill Crane	*Grus canadensis*
Black-bellied Plover	*Pluvialis squatarola*
American Golden-Plover	*Pluvialis dominica*
Semipalmated Plover	*Charadrius semipalmatus*
Lesser Yellowlegs	*Tringa flavipes*
Solitary Sandpiper	*Tringa solitaria*
Spotted Sandpiper	*Actitis macularia*
Upland Sandpiper	*Bartramia longicauda*
Whimbrel	*Numenius phaeopus*
Semipalmated Sandpiper	*Calidris pusilla*
Least Sandpiper	*Calidris minutilla*
Baird's Sandpiper	*Calidris bairdii*
Pectoral Sandpiper	*Calidris melanotos*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Common Snipe	*Gallinago gallinago*
Red-necked Phalarope	*Phalaropus lobatus*
Long-tailed Jaeger	*Stercorarius longicaudus*
Bonaparte's Gull	*Larus philadelphia*
Mew Gull	*Larus canus*
Herring Gull	*Larus argentatus*
Arctic Tern	*Sterna paradisaea*
Great Horned Owl	*Bubo virginianus*
Northern Hawk Owl	*Surnia ulula*
Great Gray Owl	*Strix nebulosa*
Short-eared Owl	*Asio flammeus*

Boreal Owl	*Aegolius funereus*
Belted Kingfisher	*Ceryle alcyon*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Three-toed Woodpecker	*Picoides tridactylus*
Black-backed Woodpecker	*Picoides arcticus*
Northern Flicker	*Colaptes auratus*
Olive-sided Flycatcher	*Contopus borealis*
Western Wood-Pewee	*Contopus sordidulus*
Alder Flycatcher	*Empidonax alnorum*
Hammond's Flycatcher	*Empidonax hammondii*
Say's Phoebe	*Sayornis saya*
Northern Shrike	*Lanius excubitor*
Gray Jay	*Perisoreus canadensis*
Black-billed Magpie	*Pica pica*
Common Raven	*Corvus corax*
Horned Lark	*Eremophila alpestris*
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Bank Swallow	*Riparia riparia*
Cliff Swallow	*Hirundo pyrrhonota*
Black-capped Chickadee	*Parus atricapillus*
Boreal Chickadee	*Parus hudsonicus*
Ruby-crowned Kinglet	*Regulus calendula*
Arctic Warbler	*Phylloscopus borealis*
Northern Wheatear	*Oenanthe oenanthe*
Townsend's Solitaire	*Myadestes townsendi*
Gray-cheeked Thrush	*Catharus minima*
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttata*
American Robin	*Turdus migratorius*
Varied Thrush	*Ixoreus naevius*
American Pipit	*Anthus rubescens*
Bohemian Waxwing	*Bombycilla garrulus*
Orange-crowned Warbler	*Vermivora celata*
Yellow Warbler	*Dendroica petechia*

Yellow-rumped Warbler	*Dendroica coronata*
Townsend's Warbler	*Dendroica townsendi*
Blackpoll Warbler	*Dendroica striata*
Northern Waterthrush	*Seiurus noveboracensis*
Wilson's Warbler	*Wilsonia pusilla*
American Tree Sparrow	*Spizella arborea*
Savannah Sparrow	*Passerculus sandwichensis*
Fox Sparrow	*Passerella iliaca*
Lincoln's Sparrow	*Melospiza lincolnii*
White-crowned Sparrow	*Zonotrichia leucophrys*
Dark-eyed Junco	*Junco hyemalis*
Lapland Longspur	*Calcarius lapponicus*
Snow Bunting	*Plectrophenax nivalis*
Rusty Blackbird	*Euphagus carolinus*
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*
Pine Grosbeak	*Pinicola enucleator*
White-winged Crossbill	*Loxia leucoptera*
Common Redpoll	*Carduelis flammea*
Hoary Redpoll	*Carduelis hornemanni*
Pine Siskin	*Carduelis pinus*

3. Large Mammals

Numerous species of terrestrial mammals inhabit the Nenana basin. Big game animals hunted in include moose, black bear, and brown bear, although most hunting is for moose and black bear. Other terrestrial mammals include furbearers and small game.

Moose *(Alces alces).* The Minto Flats provides exceptional year round habitat for moose. It is an important calving area and typically has higher calf/cow ratios than the adjacent Tanana Flats. In addition, the areas numerous lakes, ponds and wetlands vegetation provides excellent summer forage. Because of the preponderance of willow-dominated shrub fields, the Minto Flats are an important wintering area for moose and other wildlife species dependant on early seral stage vegetation. Surveys conducted in late October 2000 resulted in an estimated 2200 moose or 2.4 moose per mi^2 in the Minto Flats Management Area (MFMA) (AFD&G, 2001:4).

Moose range throughout the study area (Figure 3.2). Moose generally calve between late May and early June. They are year-round residents, although many exhibit seasonal movements related to snow depth and the availability of food. They are found in both lowland and upland shrub communities and lowland areas with ponds during summer and fall. In winter, moose concentrate in areas of relatively shallow snow depth, frequently along river drainages (ADF&G, 1994).

Moose depend on and prefer willow, birch, aspen, and cottonwood, in order of preference. Alder and willow are more important nutritionally in summer than birch leaves, while in winter, species of aspen and low-bush cranberry are more nutritionally important than birch twigs (Boggs, et al., 1997:180). Moose have high reproductive potential and can reach the carrying capacity of their range if not limited by predation, hunting and severe weather (ADF&G, 1994).

Black bear *(Ursus americanus)* and **brown bear** *(Ursus arctos)* occur within the study area (Figure 3.3). Black bear are common and widely distributed in the Minto Flats, taking advantage of the varied vegetation types and the abundance of other wildlife species, especially in riparian and wetland areas (ADF&G, 2001). Specific information on critical habitats is limited, although basic behavior patterns have been documented. Black bear distribution coincides closely with that of forested areas. Semi-open forests with an understory of grasses, herbs, and fruit-bearing shrubs, are especially attractive to black bears. Brown bears utilize all habitat types, but grass communities appear to be the most important, particularly in spring. Brown bears frequent meadows, muskegs, sedge flats, and grassy areas interspersed within forests. Salmon heads and abundant streamside blueberries are favorite foods for bears (ADF&G, 1994).

Black bears generally emerge from their dens between the first of April and mid-May. Boars emerge about a week prior to sows and cubs. Brown bears emerge from their dens beginning in late April, although females with newborn cubs may not emerge until late May. After emerging from their dens, both species move to lower elevations where they feed on early-growing green vegetation. From May to mid-July, horsetail is a particularly important food item for black bears. Black and brown bears generally remain at lower elevations throughout the summer, congregating along anadromous streams to feed on spawning salmon. In late summer and fall, black and brown bears shift to alpine and subalpine areas, where they feed on ripened berries.

Black bears generally den in forested areas, excavating their dens at the base of spruce trees. Black bear dens have been reported on the promontories that stick out into the eastern portions of Minto Flats. These areas are well drained, and the bears make use of emerging horsetail on the adjacent wetlands as an early spring food source (Hatler, 1967). Brown bears seem to prefer eskers as denning sites. Eskers are ridges or knolls of gravelly or sandy drift originally formed by streams within or under glacial ice. They are well drained and free of permafrost, allowing construction of winter dens. Aspen trees typically grow in these areas and facilitate the identification of eskers, particularly during fall when the leaves turn a brilliant gold color. Denning activities usually commence around the first of October, and most bears will have entered their dens by mid-November (Miller, 1997).

Black and brown bears mate anytime between May through July, with most of the activity occurring in June. Apart from mating, bears are solitary animals except for sows with cubs. Cubs are born in the den during mid-winter following a seven-month gestation period. One to four cubs are usually born, with two being most common. Both black and brown bear cubs usually remain with the mother for two years before separating, after which the female will breed again and produce a new litter (ADF&G, 1985b).

4. Furbearers

The mix of aquatic, wetland, and upland land cover types supports a full compliment of furbearer species, including wolf, coyote, red fox, lynx, wolverine, river otter, marten, weasels, mink, beaver, and muskrat (ADF&G, 2001).

Wolves *(Canus lupus)* den in dug-out holes in well-drained soils as deep as 10 ft. Wolves usually live in packs with parents and pups of the year. Larger packs may have two or three litters of pups from more than one female. Pack size normally ranges from 2 to 12 wolves (with an average of 6 or 7), however packs as large as 20 to 30 wolves may occur. Wolf packs tend to be territorial and stay within a particular range. Pack

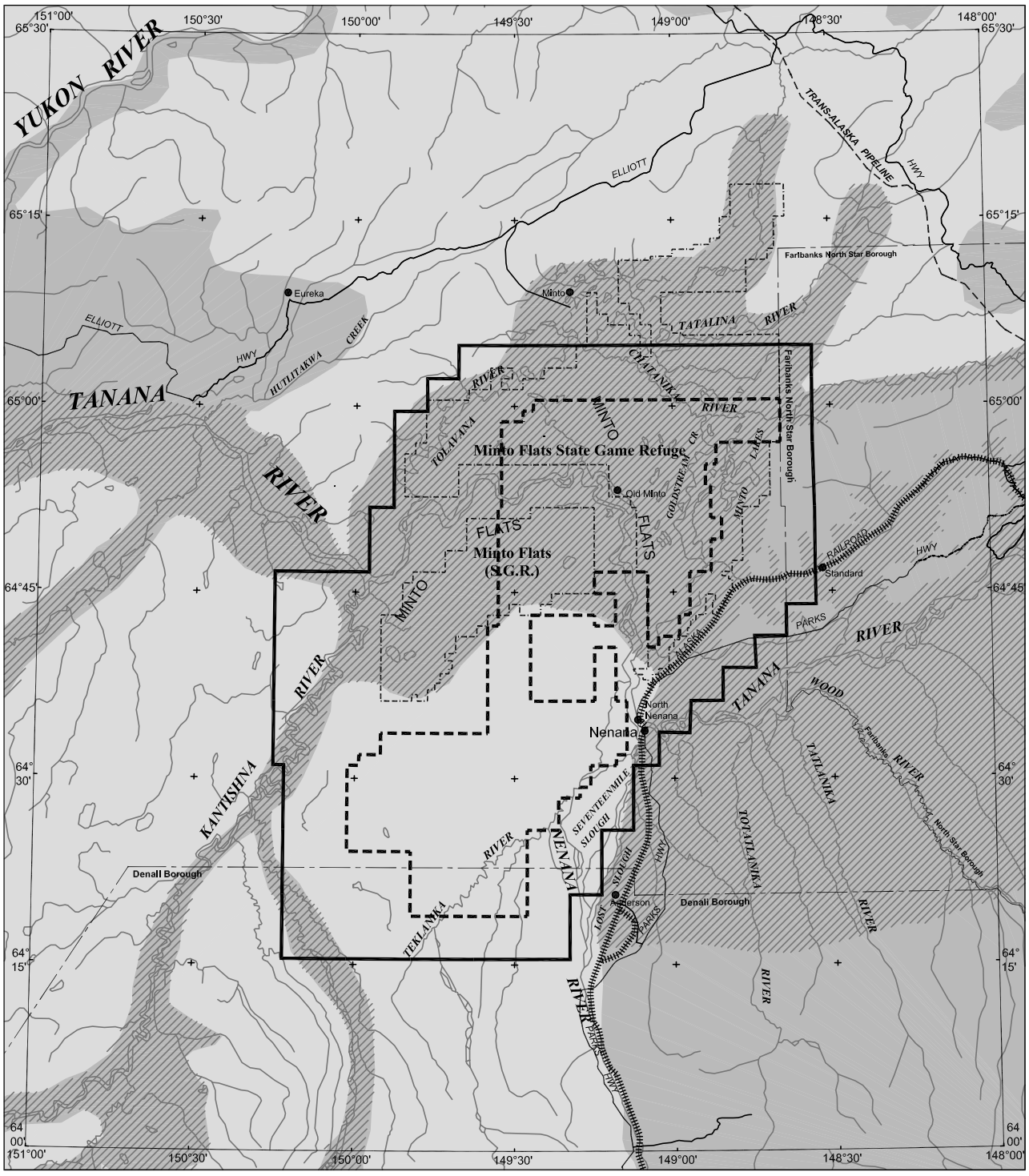

FIGURE 3.2 Moose

Nenana Basin Study Area = License Area =

General Distribution = Known Calving = Known Winter =

Source: ADF&G, 1986a

Map Area

SCALE 1:750,000 One Inch Equals 12 Miles Approx.

10 0 10 20 30 40 50 Miles

10 0 10 20 30 40 50 60 Kilometers

Map created, edited, and published by the State of Alaska, Department of Natural Resources, Division of Oil and Gas.

Albers Equal-Area Conic Projection, 1927 North American Datum, Clarke 1866 ellipsoid with a central meridian of 149° 30', origin latitude of 50°, northern parallel of 65°, and southern parallel of 55°. ADNR 7/02

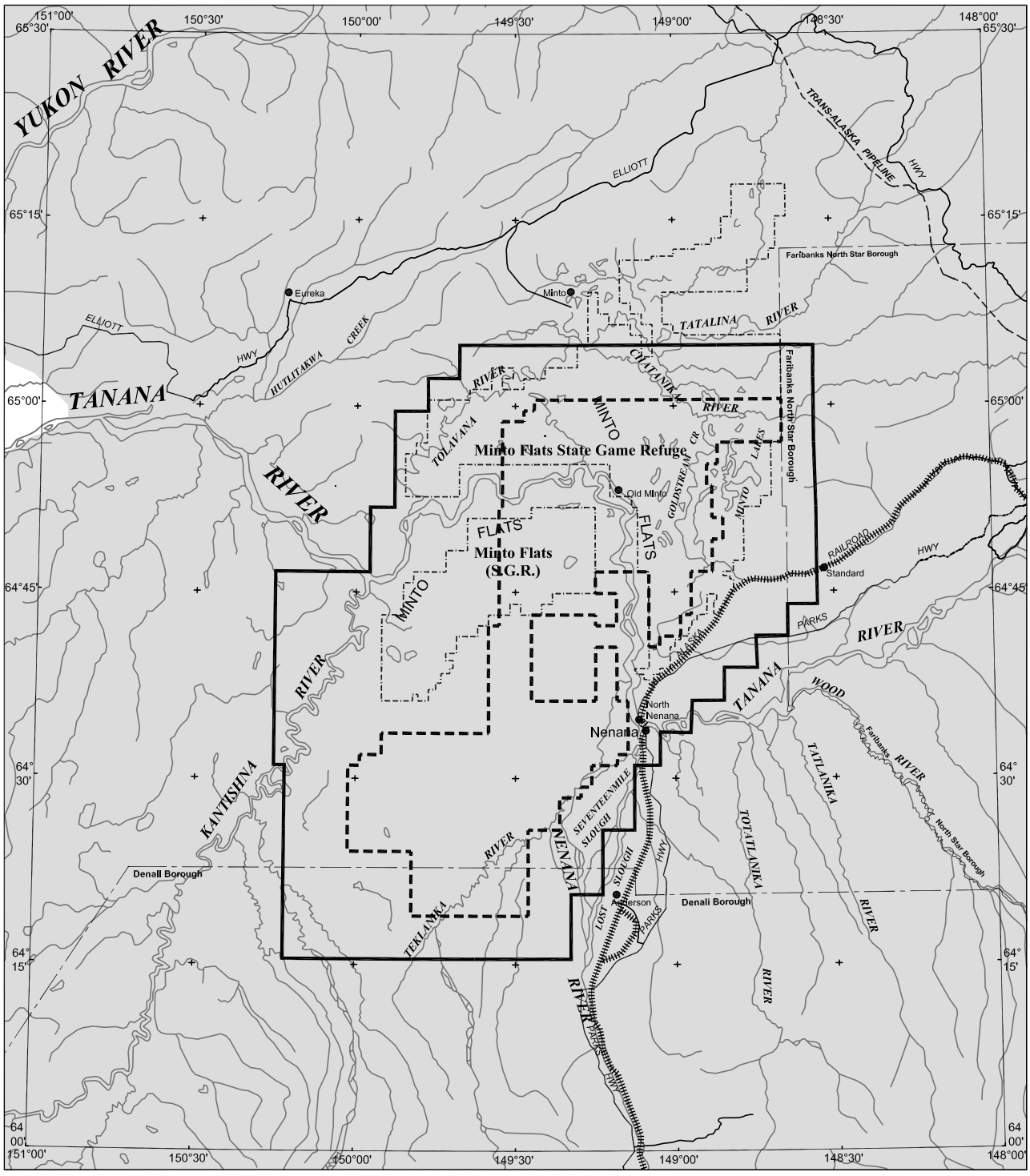

FIGURE 3.3 Brown Bear

Nenana Basin Study Area = License Area =

General Distribution =

Source: ADF&G, 1986a

Map Area

SCALE 1:750,000 One Inch Equals 12 Miles Approx.

10 0 10 20 30 40 50 Miles

10 0 10 20 30 40 50 60 Kilometers

Map created, edited, and published by the State of Alaska, Department of Natural Resources, Division of Oil and Gas.

Albers Equal-Area Conic Projection, 1927 North American Datum, Clarke 1866 ellipsoid with a central meridian of 149° 30', origin latitude of 50°, northern parallel of 65°, and southern parallel of 55°.

ADNR 7/02

territory size ranges from 300 to 1,000 mi^2 with an average of 600 mi^2 of habitat. Breeding occurs in February and March, and litters are born in May or early June. In the study area, moose are the wolf's primary food source. Voles, lemmings, ground squirrels, snowshoe hares, beaver, and occasionally birds and fish supplement the wolf's summer diet (ADF&G, 1994).

Distribution of wolves has remained relatively constant in recent decades. While birth rates are high, mortality is also high. Abundance varies with prey availability, disease, malnutrition, accidents, harvest pressure, and intra-specific strife (ADF&G, 1994).

Coyote, *(Canis latrans incolatus)* like the wolf, is a member of the dog family *(Canidae)* and resembles a medium-sized shepherd-collie type dog. The coyote is best described as an opportunistic feeder. In Alaska snowshoe hares, microtine rodents, and carrion comprise the bulk of the coyote's diet while marmots, ground squirrels, muskrats, fish, insects, and even Dall sheep are taken fewer numbers (ADF&G, 1994).

Coyotes breed in February and March. A mated pair may stay together through the spring and share parental duties after the pups are born. Other coyotes, especially young of the previous years, may also help care for the pups. Shortly before whelping, one or more dens are prepared for the litter. Coyotes give birth to an average of five to seven blind and helpless pups. The size of litters varies in response to the food supply. Litters born in times of plenty will, on the average, be larger than those born when food resources are scarce. For the first three weeks the young coyotes subsist entirely on milk. About this time some solid food regurgitated by the females is introduced into their diet, and the pups are weaned at 5-7 weeks. Once the pups establish a pattern of eating regurgitated food they will induce the parents to regurgitate by biting and clawing at their lips. At the age of 3-3.5 months the pups are able to capture food for themselves (ADF&G, 1994).

Dens are only used for whelping the young and are abandoned during the remainder of the year. When disturbed by man it is not unusual for coyotes to move the pups to another den. Family units may begin to break up as early as August, although is not unusual for them to remain together into November or even later (ADF&G, 1994).

Red fox *(Vulpes vulpes)* is usually recognized by its reddish coat, its white- tipped tail, and black "stockings," although the species does have many color variations. Red foxes breed during February and March. The den is a hole in the earth, 15 to 20 ft. long, usually located on the side of a knoll. It may have several entrances. Sometimes foxes dig their own dens. More often, though, they appropriate and enlarge the homesites of small burrowing animals, such as marmots. They also will use abandoned wolf dens. Conversely, wolves may enlarge and use a fox's den. Within the den is a grass-lined nest where well-furred but blind babies, called kits, are born after a gestation of 53 days. A litter of four kits is common, though a litter of ten is not a rarity. At birth, kits weigh about 4 ounces. Normally only one litter is born each year. The kits' eyes open 8 to 10 days after birth. The young leave the den for the first time a month later. The mother gradually weans them, and by the time the kits are 3 months old, they are learning to hunt. Both parents care for the young. The family unit endures until autumn, when it breaks up and each animal is on its own (ADF&G, 1994).

The red fox is omnivorous. Although it might eat muskrats, squirrels, hares, birds, eggs, insects, vegetation, and carrion, voles seem to be its preferred food. Foxes cache excess food when the hunting is good. They return to these storage sites and have been observed digging up a cache, inspecting it, and reburying it in the same spot. Apparently, they want to be sure that their food is still there (ADF&G, 1994).

The **lynx** *(Lynx canadensis)* is a large, short-tailed cat, similar to the bobcat, but distinguished by its long legs, furry feet, the long tufts on the tip of each ear, and a completely black-tipped tail. Mating occurs in March and early April and kittens are born about 63 days later under a natural shelter such as a windfallen

spruce, a rock ledge, or a logjam. Lynx kittens resemble domestic cats at birth and are buff colored with longitudinal streaking on their backs. Their eyes open about 1 month of age, and they are weaned when 2-3 months old. Most litters include two to four kittens, but sometimes as many as six are born and survive. Kittens remain with their mother until late winter and acquire the hunting skills and knowledge necessary for their survival (ADF&G, 1994).

The primary prey of lynx in most areas is the snowshoe hare, which undergoes an 8-11 year cycle of abundance. This cycle appears to be caused by the interaction of hares with their food and predators. Lynx numbers fluctuate with those of hares and other small game, but lag one or two years behind (ADF&G, 1994).

Wolverine (*Gulo gulo*), a relative of the mink and weasel, is the largest terrestrial member of the family Mustelidae. Wolverines become sexually mature in their second year. The breeding season extends from May through August. The abundance of food determines whether a pregnancy will be maintained and the number of young that will be born. Wolverine litters are born between January and April. No litters larger than four have been reported in the wild and most are in the range of one to three. Baby wolverines, called kits, are born blind and weigh less than 1 pound. They develop rapidly and are weaned at about 8 weeks of age. They leave their mothers at approximately 5 or 6 months to forage for themselves (ADF&G, 1994).

Wolverines travel extensively in search of food. Home range sizes are vast, with adult males using areas up to 240 mi^2. They are opportunistic, eating about anything they can find or kill. They are poor hunters but are well adapted for scavenging. The wolverine has a powerful jaw and large neck muscles allowing it to crush and utilize bones and frozen flesh. Also, wolverines can survive for long periods on little food. Their diet reflects annual and seasonal changes in food availability. In the winter, wolverines primarily rely on remains of moose and caribou killed by wolves and hunters or animals that have died of natural causes. Throughout the year, wolverines feed on small and medium-sized animals such as voles, squirrels, snowshoe hares, and birds. In the right situations, wolverines can kill moose or caribou, but these occurrences are rare (ADF&G, 1994).

The North American **river otter** (*Lutra canadensis*) is a thickset mammal with short legs, a neck no smaller than its head, inconspicuous ears, and a muscular body that is broadest at the hips. Its tail is powerful and a little more than a third as long as its head and body. Only the hind feet are webbed. River otters in Alaska breed in spring, usually in May. Mating can take place in or out of the water. One to six pups (usually two or three) are born the next year any time from late January to June following a gestation period of 9 to 13 months. The pups are born toothless and blind in a den that is usually a subterranean burrow. When about 2 months old, they begin to leave the den and shortly thereafter start to swim and eat solid food. They are taught to swim by the female who must coax or drag them into the water. Pups are weaned when about 5 months old. They will stay with their mother until shortly before her next litter is born. River otters are sexually mature when 2 years old. A female will then mate with the male of her choice and produce one litter each year. Otters can live and breed for more than 20 years (ADF&G, 1994).

River otters eat snails, insects, frogs, a variety of fish, and occasionally birds, mammals, and vegetable matter. Aquatic organisms no bigger than a man's finger are usually eaten at the surface of the water; larger food is taken ashore. If fish or other animal is too big to be eaten at one meal, the remains are abandoned and become available to other flesh-eating mammals and birds. Scraps left out of the water may be a significant source of food available to some scavengers when snow and ice are present (ADF&G, 1997).

Marten (*Martes americana*) is a carnivorous, furbearing relative of the mink with a coat that is characterized by soft, dense fur which varies in color from pale yellow to dark brown, shading to black on the feet and legs: Mating occurs in July and August. Fertilization is followed by a period of delayed implantation, during which the fertilized eggs do not develop. After six months the eggs become active and embryos begin to develop, growing rapidly for 2 to 3 months. The litter, averaging three young, is born in April or early

May. Young weigh about 1 ounce at birth and are covered with fine, yellowish hair. By early fall the young martens can forage for themselves (ADF&G, 1994).

Marten depend heavily on meadow voles and red-backed voles or mice, which are their primary food source over. Probably the second most critical food source is berries, especially blueberries, followed by small birds, eggs, and vegetation. The marten is a voracious and opportunistic feeder. Carrion such as the remains of wolf kills or salmon carcasses are eaten in many areas. Wild marten are fond of sweets such as jam. They will sometimes take treats from humans (ADF&G, 1994).

Weasels (*Mustela erminea*) are the smallest members of the family Mustelidae. General description: In summer, weasels are medium to dark brown above, with yellowish white underparts. They turn white in winter. Mating typically occurs in mid- to late summer. In Alaska, litters of 3 to 10 young are born from early May through June. Weasels usually nest in small rodent burrows, stumps, rock outcroppings, or under old buildings. The nest is often lined with mouse fur. The number of young born and the number that survive until weaning depend in large part on the abundance of food in the mother's home range. Young weasels remain in the den for 30 to 45 days, at which time they are about two-thirds grown. After emerging, they stay near the home den for a week or two before beginning to accompany their mother on foraging trips. At 80 to 85 days of age (early fall) they reach full size. At this time, they disperse away from their mother's home range (ADF&G, 1994).

Weasels feed primarily on mice. When mice are not abundant, weasels will also take shrews, pikas, birds, fish, and insects. Weasels have a high metabolic rate, which drives them in search of prey. They eat 40 percent or more of their body weight daily. During the whelping period, female weasels kill and consume an average of four mice per day. Their fast and furious pace allows only short periods of inactivity. Total daily rest time averages a few hours. Nature seldom provides a steady source of food. The weasel's mode of survival involves killing whatever it can, whenever it can. When confronted with an abundance of mice, the voracious weasel follows the only pattern it knows and will kill more than it can eat at one time. Dens often have a side chamber used as a storeroom for surplus slain mice (ADF&G, 1994).

Mink (*Mustela vison*) and other fur bearing animals attracted trappers, traders, and settlers to Alaska from around the world. A mink's fur is in prime condition when guard hairs are thickest. Mink are then a chocolate brown with some irregular white patches on the chin, throat, and belly. Adult males range in total length from 19 to 29 inches. They may weigh from three to almost five pounds. Females are somewhat smaller than males. The breeding season extends from March through April. The young within a single litter can be the result of fertilization by different males and/or two different ovulations more than a week apart. The total gestation period varies from 40 to 75 days. Once the egg implants, fetal development takes about 30 days to complete. In Interior and western Alaska most births occur during June (ADF&G, 1994).

Mink will eat virtually anything they can catch and kill, including fish, birds, bird eggs, insects, and small mammals. There are both seasonal and annual differences in the diet depending on what is available. Mink prefer streams, ponds, or marshes. An abundance of hares or mice may cause them to move inland. Adult mink have been known to kill and eat young mink (ADF&G, 1994).

Beaver (*Castor canadensis*) is North America's largest rodent. They continue to grow throughout their lives and may reach 3 to 4 ft. long, including tail. Although most adult beavers weigh 40 to 70 pounds, very old, fat beavers can weigh as much as 100 pounds. Beavers in the wild live about 10 to 12 years. They have been known to live as long as 19 years in captivity. The beaver's heavy chestnut brown coat over a warm soft underfur keeps the animal comfortable in all temperatures. Its large, webbed feet and broad, black tail (about 10 inches long and 6 inches wide) can be used as a rudder when swimming (ADF&G, 1994).

In order to survive, beavers must be assured of 2 or 3 ft. of water year round. Water provides a refuge from enemies. Beavers build canals to float and transport heavy objects such as branches and logs for food

and construction. Food for winter use must be stored in underwater food caches. If the habitat does not have the necessary water level, beavers construct dams. After mating (which takes place in January or February), the female prepares for a new litter. One to six kits are born anytime from late April to June. Their eyes are open at birth, and the kits are covered with soft fur. They can swim immediately. The young beavers live with their parents until they are 2 years old. Then they leave to find their own homes (ADF&G, 1994).

The life of a beaver colony is governed largely by food supply. Beavers eat not only bark, but also aquatic plants of all kinds, roots, and grasses. As they exhaust the food supply in the area, the beavers must forage farther from their homes. This increases the danger from predators. When an area is cleared of food, the family migrates to a new home. In Alaska wolves, lynx, bears, and humans are important predators of beavers (ADF&G, 1994).

Muskrat (*Ondatra zibethicus*). The highest populations of muskrat are in the broad floodplains and deltas of major rivers and in marshy areas dotted with small lakes. The muskrat's small size and rat-like tail are the most immediate identification marks. Muskrats weigh from 2 to 4 pounds. They measure 10-14 inches in length, excluding their 8-11 inch tails. Their coats consist of soft, dense underfur and long, coarse, shining guard hairs (ADF&G, 1994).

Muskrats have both a high reproductive and population turnover rate. Mature females usually have two litters per year and annually give birth to 15 young, or 7 to 8 per litter. Mating begins as soon as there is open water in the spring. In Interior Alaska this date may range from late April to mid-May, and the young resulting from this first mating are born in early to mid-June. Females mate again three to five days after the first litter. Their second litter is born about 25 days later. Thus there are two peaks in breeding activity separated by about 30 days. Evidence indicates that male muskrats remain at the same den with the female for several weeks. The young are weaned at about 1 month of age, but may stay with the parents for a while longer. Second litters often overwinter in the same den with their parents (ADF&G, 1994).

Muskrats are basically herbivorous. They feed mainly on aquatic plants such as the roots and stems of cattails, lilies, sedges, and grasses. They may occasionally eat some animal life such small fish. Vegetation is collected and stored during the summer for winter use. As the ice thickens during the winter, less area is available for foraging. Muskrats are forced to leave shallow ponds to spend their time in deeper ponds to search for food. Deep ponds and channels often have less aquatic vegetation than shallower ones, thus they can support fewer muskrats. Competition for food causes rapid depletion of the available supply. This may result in exhaustion of food supplies and subsequent fighting, starvation, or emigration of the muskrat (ADF&G, 1994).